TITLE OF THE INVENTION - Drag Reduction Channel Apparatus for Roadway Vehicles

CROSS REFERENCE TO RELATED APPLICATIONS - None

I. Background of the Invention

1. Field of Invention

An air diversion device captures a flow of air from above a roadway vehicle, more specifically large tractor trailer rigs operating over the highway, and forcibly diverts the captured air to the heart of the low pressure air void created behind the roadway vehicle as it passes over a roadway, reducing the amount of drag force applied to the roadway vehicle, thus increasing and enhancing the efficiency of operation of the roadway vehicle. The diversion device includes at least one air intake manifold placed on the top of the roadway vehicle near the rear of the roadway vehicle, a channeled duct system, and a forced air outlet projecting the forced air gathered by the air intake manifold through the channeled duct system, ejecting the forced air in a relatively horizontal plane into the mid-center portion of the rear of the roadway vehicle at a highly accelerated rate.

2. Description of Prior Art

The following United States patents were discovered and are disclosed within this application for utility patent. All relate to air channelers, truck air ducts and drag reduction mechanisms, all relative to truck efficiency.

In U.S. Patent No. 5,171,057 to Sharp, an air channeler is disclosed wherein an entrance opening collects an amount of air from either a disclosed upper or side portion of a tractor trailer and channels the air into the center of the rear of the truck to provide the deflected air to the rear of the truck not only to minimize air drag and vacuum behind the truck, but to also keep the rear surface of the truck clean from debris and also to provide an amount of liquid cleaner to the rear surface

through feed lines and a fluid pump mechanism. This device is provided as either attached to the swinging doors, FIG. 4, or pivotally mounting to the sides of the truck and moved out of the way for a sliding overhead door, FIGS. 7-10. The entrance opening and the exit openings appear to be and are disclosed as being the same size, and the exit opening does not eject the air outward from the rear of the truck, but to the rear center of the truck.

The duct apparatus of U.S. Patent No. 4,320,920 to Goudey attaches to the corners of a semi-tractor trailer, van or bus and diverts air perpendicularly into the rear plane of the applied vehicle. U.S. Patent No. 6,561,575 to Fairburn is an air channeler which derives intake air from the underside of a trailer and diverts the air through a cylindrical conduit to the rear of either the tractor or trailer or both. This duct has a damper located within the conduit. The air conduit is provided into two sections- a stationary section, terminating at its rearward end into a lip, just forward of the rearmost surface of a rear bumper of the trailer. A moveable portion has an upright portion and an elbow, with the elbow projecting forward a distance under the trailer, terminating in a lip. A rubber seal is applied to the lip of the elbow and the pressed against the lip of the rearward end of the stationary section, sealing the two section of the conduit. The air inlet is greater in diameter than the conduit and is located on the undercarriage of the semi-tractor trailer in front of the rear wheels to minimize the intake of more turbulent air.

The current channel apparatus, preferable provided in a pair of matched sets, scoops smooth air from the upper surface or roof of the roadway vehicle into an enlarged intake portion of an intake manifold which funnels the gathered air horizontally into a transfer end of the intake manifold. The funneled and accelerated compressed air is transferred into an flexible elbow which is removably inserted within the transfer end of the intake manifold, the elbow being made of a compressible and

expandable material, the elbow further directing and diverting the air vertically to a downdraft duct attached to the rear surface of the roadway vehicle. The downdraft duct has a draft vent opening to promote the flow of air through the downdraft duct and to relieve stress upon on the downdraft duct, the downdraft duct having a ramped exhaust port with a removable dispersion screen, diverting the air from the downdraft duct directly outward from the rear surface of the roadway vehicle into the heart of a low pressure void behind the roadway vehicle, filling the void as quickly as possible with the ejected accelerated high velocity air. The ratio of the square dimension area of exhaust port of the downdraft duct to the intake portion of the intake manifold is at least 1: 5, to promote the most rapid filling of the low pressure void as possible.

II. Summary of the Invention

Drivers of roadway vehicle of a large size are hampered in the cost of travel and transport by a low pressure draft created behind their vehicles, as documented in the prior art cited above. For several years, attempts have been made to provide devices to either stem the flow of air around the vehicles, or to divert or channel air into the low pressure void. While several devices have provided air to the rear of the vehicle, none of them have disclosed an apparatus that collected air, accelerated and compressed the air flow through a channel and ejected the accelerated and compressed air directly into the center or heart of the low pressure void created by the moving roadway vehicle, filling the low pressure void in a rapid manner as indicated by the current invention.

The primary objective of the invention is to provide a means of gathering smooth horizontal air from an upper surface of a roadway vehicle, compressing and accelerating the air through a substantial and mechanical tapered manifold and transferring the compressed and accelerated air vertically through a downdraft duct with a draft vent opening, and ejecting the compressed and

accelerated air in a horizontal plane into a low pressure air void directly behind the roadway vehicle, converting the smooth upper air into forced linear air directed to the void to the fill the low pressure void in a rapid manner.

A second objective of the apparatus is to create the proper acceleration and compression of air by the apparatus by making the square area of the intake portion of the apparatus at least five times larger than the square area of the exhaust portion of the apparatus.

A third objective is to provide the device in a mode which will not interfere with access to the rear of the roadway vehicle to open and shut doors on the rear of the roadway vehicle.

A fourth objective of the device is to improve upon the prior art which did not provide for a means of accelerating and compressing air through their devices, did not provide an adequate mode to prevent and eliminate impedance to access to the rear of the vehicle to which they were mounted, and provide for the gathering of smooth air from the upper surface of the roadway vehicle as opposed to turbid air from the underside and sides of the vehicle, diverting this accelerated air directly outward into the center of the low pressure void at the rear of the vehicle.

III. Description of the Drawings

The following drawings are submitted with this utility patent application.

Figure 1is an upper perspective view of two pair of the drag reduction channel apparatuses attached to a roadway vehicle.

Figure 2 is a rear view of the intake manifold.

Figure 3 is a front view of the intake manifold along lines 3/3 of Figure 2.

Figure 4 is a rear view of the intake manifold along lines 4/4 of Figure 2.

Figure 5 is a side view of a first embodiment of the elbow for a common box trailer.

Figure 6 is a side view of a second embodiment of the elbow for a refrigerated tractor trailer.

Figure 7 is a front view of the downdraft duct.

Figure 8 is a side cross section view of the downdraft duct along Line 8/8 of Figure 7.

Figure 9 is an expanded drawing of the drag reduction channel apparatus.

Figure 10 is a side cross-section of the intake manifold and the elbow in an engaged mode.

Figure 11 is a top cross-section of the intake manifold and the elbow in an engaged mode.

IV. Description of the Preferred Embodiment

A drag reduction channeled apparatus, preferably supplied in two tandem sets, attaches to an upper surface **102** of a rear portion **104** of a roadway vehicle **100** to collect smooth air from above the roadway vehicle **100** which is further forcibly expelled into a low pressure void behind the roadway vehicle **100** during travel, shown in FIGS. 1-11 of the drawings, each drag reduction channeled apparatus comprising at least one tapered intake manifold **20** attached to the upper surface **102** of the rear portion **104** of the roadway vehicle **100**, the intake manifold **20** having an enlarged intake portion **22** and a reduced transfer end **24**, an elbow **40a, 40b** having an intake end **42a, 42b** adapted to fit within the reduced transfer end **24** of the intake manifold **20**, a bent portion **44a, 44b** and an output end **46a, 46b**, a downdraft duct **60** having a receiving end **70** connecting to the output end **46a, 46b** of the elbow **40a, 40b** by a connector brace **50**, a flow portion **72** including a draft vent opening **80** to provide flow enhancement to the downdraft duct **60**, and a terminal end **74** having a ramped exhaust port **82** including an internal deflector ramp **84** to direct air flowing through the downdraft duct **60** outward in a horizontal plane, the terminal end **74** having a removable dispersion screen **90**, the connector brace **50** and the downdraft duct **60** attaching to a rear panel **106** of the roadway vehicle **100.**

The intake manifold **20**, more specifically shown in FIGS. 2-4 of the drawings, is further defined as having the enlarged intake portion **22** being relatively rectangular and having a straight front edge **25** with at least two internal support fins **30** aligned perpendicular to the front edge **25** attaching to a lower surface **27** of an upper panel **26**, at least two air deflection ramps **32** attaching to inner surfaces **29** of opposing tapered side panels **28**, each air deflection ramp **32** further diverting air within the intake manifold **20** away from the side panels **28** prior to the air flowing within the intake manifold **20** reaching the transfer end **24** of the intake manifold **20.** The transfer end **24** of the intake manifold **20** is also relatively rectangular but significantly smaller in size than the enlarged intake portion **22**, the area of the transfer end **24** preferably at least five times smaller than the area of the enlarged intake portion **22** of the intake manifold **20**, providing the intake manifold **20** with the desired taper, as shown in FIG. 2 of the drawings.

Extending outward from the side panels **28**, indicated in FIGS. 1, 2, 4 and 11, are attaching flanges **34** having a plurality of holes **36** which accept either rivets, screws or bolts to attach the intake manifold **20** to the upper surface **102** of the rear portion **104** of the roadway vehicle **100.** It is preferred that the intake manifold **20** be made entirely of a rigid sheet metal material to prevent potential deformity due to the intensive wind flow created by the roadway vehicle **100** traveling at highway speeds, with the internal support fins **30** maintaining the shape of the intake manifold **20** and preventing collapse of the intake manifold **20** during highway travel.

The elbow **40a, 40b** is further defined in two embodiments, but commonly as a bent rectangular duct. A first embodiment of the elbow **40a,** shown in FIGS. 1, 5 and 9-11 of the drawings, is adapted to a box trailer having panel doors **110** which open outward from side hinges **112.** A second embodiment of the elbow, **40b**, shown in FIG. 6 only of the drawings, is adapted to

a refrigerated box trailer. Refrigerated box trailers have a roof which extends beyond the rear panel of a roadway vehicle **100**, requiring the elbow **40b** to be bent for a portion at an angle beyond ninety degrees, as indicated in FIG. 6, whereas a non-refrigerated box trailer has a rear panel **106** and roof forming an even common edge which would be best fitted by an elbow **40a** having a straight ninety degree bend, as in FIG. 5. It is preferred that the elbow **40a, 40b** be made of a flexible and expandable material in at least the bent portion **44a, 44b** of the elbow **40** if not the entire elbow.

The intake end **42a, 42b** of the elbow **40a, 40b** is slightly smaller than the transfer end **24** of the intake manifold **20** and is adapted to fit within the reduced transfer end **24** of the intake manifold **20** with the intake end **42a, 42b** of the elbow adapted to be inserted and removed from the transfer end **24** without deformity while still occupying as much of the transfer end **24** of the intake manifold **20** as possible, shown in FIGS. 10 and 11 of the drawings. The air deflection ramps **32** should terminate slightly in front of the intake end **42a, 42b** of the elbow **40a, 40b**, indicated in FIGS. 10 and 11, when the intake end **42a, 42b** of the elbow is fully inserted within the transfer end **24** of the intake manifold **20**, the air deflection ramps **32** channeling air into the intake end **42a, 42b** of the elbow and minimizing air flow around the intake end **42a, 42b** of the elbow **40a, 40b.** For the remainder of this specification, the two embodiments will be discussed as one, with the elbow, intake end, bent portion and output end referenced generically as reference numbers **40**, **42**, **44** and **46** respectively, without an **a** or a **b.**

The output end **46** of the elbow **40** should be the same dimension, size and shape as the input end **42** of the elbow **40.** The output end **46** of the elbow should also be the same size, shape and dimension as the receiving end **70** of the downdraft duct **60**, wherein the output end **46** of the elbow **40** and the receiving end **70** of the downdraft duct **60** are mated when abutting each other. The

connector brace **50** is placed over the abutted receiving end **70** of the downdraft duct **60** and the output end **46** of the elbow **40**, FIG. 1 and 9, forming a sealed connection between the elbow **40** and the downdraft duct **60**, the connector brace **50** also anchoring the elbow **40** and the receiving end **70** of the downdraft duct **60** to the rear panel **104** of the roadway vehicle **100**, which could be the rear panel **106** of a transport bus, a motor home, the panel doors **110** on the rear portion **106** of a semi-tractor trailer, a semi-tractor, or any vehicle traveling on a roadway.

The downdraft duct **60** is further defined and specifically shown in FIGS. 7-8 of the drawings, showing the downdraft duct **60** to also have a front panel **62**, a rear panel **64** and two side panels **66.** The receiving end **70** of the downdraft duct **60** is adapted to match and mate with the output end **46** of the elbow **40.** The downdraft duct **60** is most preferably made of a rigid sheet metal, as is the intake manifold **20.** The draft vent opening **80** is provided on the front panel **62** of the downdraft duct **60** to provide two functions. First, the draft vent opening **80** enhances air flow through the downdraft duct **60** by creating a suction force directed downward through the draft vent opening **80** using what is commonly known to those skilled in the art as the "Buchner effect" (Ernst Buchner) by allowing secondary air introduction through the downdraft duct **60.** Second, the draft vent opening **80** aids in the prevention of collapse of the downdraft duct **60** by providing a reduction of force to the front panel **62**, rear panel **64** and two side panels **66**, actually forcing them outward instead of inward upon each other. The downdraft duct **60** is further attached to the same surface as the connector brace **50** by attaching flanges **86** extending from the rear panel **64** and two side panels **66**, the attaching flanges **86** also having a plurality of holes **88** which accept either rivets, screws or bolts to attach the downdraft duct **60** to the applied surface.

At the terminal end **74** of the downdraft duct **60**, the ramped exhaust port **82** opens outward

through the front panel **62.** At the terminal end **74** is the internal deflector ramp **84**, which is concaved and curved from the rear panel **64** to the front panel **62**, attached to the two side panels **66**, to divert the air flow outward in a horizontal plane, into the middle of the rear panel **106** of the roadway vehicle **100**, which is the location of the greatest low pressure void behind the roadway vehicle **100.** Covering the ramped exhaust port **82** is the removable dispersion screen **90**, serving three purposes. First, the removable dispersion screen **90** is intended to spread the exhaust air to some extent. Second, it is intended that the removable dispersion screen **90** divert the air flow to an optimal location behind the roadway vehicle and stem the air flow to that optimal location, the diversion screen possibly containing adjustable louvers to accomplish this diversion. Third, the removable dispersion screen **90** prevents solid matter which might be sucked into the intake manifold **20** from being projected out of the ramped exhaust port **82** at a high velocity, which could pose hazard to a trailing vehicle. The removable dispersion screen **90** may be embodied as an upwardly sliding dispersion screen, not shown, which could be raised and lowered within the downdraft duct **60** within sliding channels mounted on an inner surface of the two side panels of the downdraft duct **60**, also not shown, but contemplated within the scope of this invention.

In the event that the apparatus is applied to a semi-tractor trailer, which is the most suitable application of the apparatus as indicated in FIGS. 1 and 10-11 of the drawings, the elbow **40** and downdraft duct **60** remain attached to the panel doors **110**, swinging away from the rear panel **106** of the trailer, but not so as to impede the opening and closing of the panel doors **110.** The intake manifold **20** remains secured to the upper surface **102** of the rear portion **104** of the semi-tractor trailer when the panel doors **110** are open.

It is contemplated within the scope of this invention that the entire drag reduction channel

apparatus may either be supplied as an after market product to attach to the roadway vehicle. However, it is also contemplated that the drag reduction channel apparatus may be installed as an embedded and incorporated factory apparatus which is provided with the intake manifold **20** provided as an upper extension of the roof of the roadway vehicle, with the elbow **40** and downdraft duct **60** formed within the body of the roadway vehicle, with the ramped exhaust port **82** and the removable dispersion screen **90** opening outward from the rear panel **106** of the roadway vehicle **100.** This particular embodiment is not shown in the drawings.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is: